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ABSTRACT

The effects on short- and long-term recall of words varying in arousal value inserted into prose were studied in 720 fifth-grade children. A 2 x 2 x 2 x 3 design was used consisting of two levels of word arousal value (high and low), two retention intervals (immediate and one week), two directions of the to-be-recalled words from the inserted arousal words (preceding or following the arousal words), and three distances of the to-be-recalled words from the inserted arousal words (one, three, or five words distant). Results were analyzed according to three error types: extralist, intralist, and omissions. No main effect of arousal or interaction with retention interval was obtained. The extralist error analysis revealed that high-arousal words significantly facilitated performance in a forward direction and inhibited or impaired it in a backward direction relative to the effects of the low-arousal words, which inhibited or impaired performance in a forward direction and facilitated it in a backward direction. The direction of this interaction was the same, though not significant, for the omission errors. Intralist errors were so low as to make consideration of them of dubious value. (Author/DI)

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Technical Report No. 242

CHILDREN'S LEARNING FROM DISCOURSE: WORD AROUSAL AND SPREAD-OF-AROUSAL EFFECTS IN SHORT- AND LONG-TERM RETENTION

by

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Report from the Project on
Motivation and Individual Differences
in Learning and Retention

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Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

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Abstract

The effects on short- and long-term recall of words varying in arousal value inserted into prose was studied in 720 fifth-grade children. A 2 x 2 x 2 x 3 design was used consisting of two levels of word arousal value (high and low), two retention intervals (immediate and one week), two directions of the to-be-recalled words from the inserted arousal words (preceding or following the arousal words), and three distances of the to-be-recalled words from the inserted arousal words (one, three, or five words distant). Analysis of the results was based on errors, considering three error-types: extralist, intralist, and omission errors. No main effect of arousal or interaction with retention interval was obtained. The extralist error analysis revealed that high-arousal words significantly facilitated performance in a forward direction and inhibited or impaired it in a backward direction relative to the effects of the low-arousal words, which inhibited or impaired performance in a forward direction and facilitated it in a backward direction. The direction of this interaction was the same, though not significant, for omission errors. The incidence of intralist errors was so low as to render consideration of them of dubious value.

I
Introduction

The experimental study of the role of motivational variables in verbal learning and verbal behavior has received scant attention from psychologists, although any classroom teacher will argue for the paramount importance of such variables. One paradigm that appears fruitful is that of arousal effects on learning and memory, in which motivation is described as an arousal condition of the organism that (a) is affected by stimulus properties of the learning task, or (b) fluctuates, perhaps randomly, during learning, or (c) is a characteristic response of a given S in learning situations, that is, an individual difference variable. Research in this paradigm has suggested that arousal, measured physiologically, is related to short- (STR) and long-term retention (LTR) such that STR is poor following high-arousal learning relative to STR following low-arousal learning, and that the reverse is true of LTR (Farley, 1970a). This finding seems to be restricted to list learning situations and is best demonstrated with GSR over other physiological measures, or with arousal treated as an individual difference measure (Farley, 1970a). Although no STR-LTR studies of connected discourse or prose have been undertaken utilizing ongoing physiological measures, the retention-arousal interaction has not been obtained in prose when arousal was treated as an individual difference variable; however, the relevant studies have been subject to criticism (Farley, 1970b).

Some of the arousal and list learning experiments have performed putative manipulations of arousal through characteristics of the words studied. Words have been defined a priori as either high or low in arousal-eliciting properties either through the experimenter's own judgment or on the basis of affective ratings of the words by Ss. In such a study, Farley (1969) demonstrated that although in homogeneous lists high-arousal words were undifferentiated from low-arousal words on STR tests, they were significantly better recalled at LTR. However, when a mixed list of high- and low-arousal words was used, the high-arousal words were better recalled at both STR and LTR tests, suggesting a context or contrast effect.

In extending arousal and memory analyses to connected discourse, it can be expected that context effects such as those demonstrated by Farley (1969) will often be operative, since the word arousal properties will be contrasted with the affective import of the remaining sentence and passage environment. Thus it might be expected that word arousal would tend to have main effects at both STR and LTR tests rather than interactive effects, or lack of effects at STR but significant effects at LTR. It might also be expected that word arousal properties would have a spread of effect in prose, such that the recall of items adjacent to the high-arousal word would be greater than the recall of more distant items. The comparative strength of such an effect in a forward versus backward direction might suggest the implication of altered attentional or search processes (forward effect), arousal effects on memory consolidation (backward effect), or perhaps rehearsal.

The present study was undertaken to investigate the effects of word arousal on recall in prose learning including analyses of possible spread-of-arousal effects.

II
Method

Subjects

The Ss were 720 fifth-grade students in six schools. This number comprised most of the available population of fifth-grade students in these Midwest, predominantly white, middle-class schools.

Materials

The prose passage used was 230 words in length. Within the passage, every 21st word was an "arousal event," i.e., it varied as to arousal properties (high versus low). There were ten such words or arousal events in the passage. The high- and low-arousal words were taken from the DiVesta and Walls (1970) list in which fifth graders comparable to the present Ss rated 487 words on a number of semantic dimensions. A 1-7 point scale of the dimensions friendly-unfriendly, good-bad, and nice-awful was used in constructing the present lists. Words rated between 1.00 and 2.60 on two out of three dimensions were used as high-arousal (positive emotionality) words, while words rated between 3.5 and 4.5 on two out of three dimensions were used as low-arousal (neutral emotionality) words. Thus, the high-arousal words were extreme in the "positive" direction on the emotionality continuum used (as opposed to "negative" direction), while the low-arousal words were neutral on the emotionality continuum. The high- and low-arousal lists were equated with respect to such major verbal learning variables as Thorndike-Lorge frequency, but had non-overlapping distributions on the "arousal" dimension. In addition to the foregoing considerations, the passage with the ten high-arousal words and the same passage containing instead the ten low-arousal words were equated by cloze procedure such that on a comparable pilot sample of children it was found that with every 21st word missing, the probability of guessing a high- or low-arousal word at each location was equal. Thus, within the context of the passage used, the probability of occurrence of the high- or low-arousal words was equivalent by cloze technique. The low-arousal words were: slow, hunter, door, tobacco, habit, thirsty, nail, boss, esteem, backward. The high-arousal words were: gentle, priest, light, lamb, practice, strong, flower, head, approval, generous. The passage concerned a fictitious primitive tribe (the Wahoos) in a fictitious country (South Langu) and was written at an age-appropriate reading level.

Procedure

In order to study an hypothesized spread-of-arousal effect, words selected for recall were located either one, three, or five words before or after the arousal word or "arousal event." Two retention intervals (immediate test versus one week) were chosen based on previous work on arousal and memory (Farley, 1970a). A 2 x 2 x 2 x 3 design was used consisting of two levels of word arousal (high and low), two retention intervals (immediate and one week), two directions of the target or to-be-recalled words (preceding or following the arousal event), and three distances of the target word from the arousal event (one, three, or five words removed).

In order to test for spread of arousal effects, the recall task consisted of the cloze technique with the target word missing. The blank to-be-filled-in space occurred either one, three, or five words before or after a given arousal word, depending upon the experimental condition. At the end of the experiment a four-item measure of the S's attitude toward

the passage content was administered, using for each item a seven-point scale ranging from "strongly agree" to "strongly disagree." The four items were: A. I would like to visit South Langu, B. I would like to be a Wahoo, C. I like the traditions of the Wahoos, D. I would like to study the Wahoos.

The materials were presented in booklets. On the first administration, the booklets consisted for the short-term retention (STR) Ss of the passage on one page followed by the cloze recall test on the next page. For the long-term retention (LTR) Ss, however, the passage was followed not by the retention measure but by a filler page requiring the S to complete the page with X's and O's. On the test one week later, both the STR and LTR Ss received the cloze recall task and the attitude measure, with the STR Ss being retested primarily as a check on mortality rates.

Subjects were randomly assigned, within classrooms, to experimental conditions. On the first test administration, Ss were given 5 minutes to read the passage, and were then instructed to turn the page at which point they encountered either the cloze task (STR Ss) or the filler task (LTR Ss), for which they were allowed 5 minutes. Five minutes were also allowed for the cloze task and 5 minutes for the attitude measure one week later.

III
Results

In analyzing the recall results, errors formed the basic data, with intralist, extralist, and omission errors being considered, thus allowing for a fine-grained analysis of recall performance. It should be noted that the extralist errors were not necessarily extra-passage errors, but merely errors not from the target word list. The mean error scores in the various groups are presented in Table 1. The data summarized in Table 1 were subjected to analysis of variance. The results of this analysis are summarized in Table 2. Interestingly, there was no significant retention effect for intralist errors, although extralist errors demonstrated significant increase and omission errors significant decrease over time, as indicated in Table 3. All error types were significantly affected by distance from the arousal

Table 1
Mean Scores on the Dependent Measures

Arousal Condition	Retention Interval	Distance from Arousal Word	Before (B) or After (A)	Intralist	Extralist	Omission	Attitude Scale Items 1	2	3	4
Low	Short	1	B	.83	2.00	1.00	.69	1.17	1.28	.93
Low	Short	1	A	.25	3.25	1.19	1.19	1.66	1.38	1.41
Low	Short	3	B	.75	3.14	1.79	1.07	1.25	.93	1.00
Low	Short	3	A	.14	1.93	2.45	.70	1.31	1.10	.97
Low	Short	5	B	.17	3.07	1.97	1.06	1.57	.80	1.10
Low	Short	5	A	.27	4.03	2.57	1.23	1.97	1.30	1.47
Low	Long	1	B	1.13	2.45	.58	1.48	1.93	1.29	1.39
Low	Long	1	A	.48	3.97	1.07	.83	1.17	.90	1.17
Low	Long	3	B	.65	4.03	1.77	.81	1.39	1.16	1.03
Low	Long	3	A	.61	4.48	1.19	1.06	1.29	.94	.77
Low	Long	5	B	.13	5.00	1.00	1.27	1.77	1.10	1.17
Low	Long	5	A	.34	5.22	1.22	.97	1.34	1.28	1.34
High	Short	1	B	.43	2.67	1.80	.87	1.37	.97	.90
High	Short	1	A	.35	2.38	1.48	1.10	1.31	1.35	1.10
High	Short	3	B	.67	3.63	2.50	.87	.97	.97	.77
High	Short	3	A	.35	2.00	2.59	1.00	1.31	.93	1.14
High	Short	5	B	.24	2.69	1.83	1.24	2.00	1.45	1.28
High	Short	5	A	.42	3.48	2.84	1.16	1.71	1.35	1.26
High	Long	1	B	1.10	3.77	1.03	.63	1.17	.60	.67
High	Long	1	A	.43	3.77	.57	.83	1.73	1.37	1.03
High	Long	3	B	.36	5.13	1.87	1.03	1.55	.90	1.13
High	Long	3	A	.62	2.93	.79	.55	1.38	.90	.86
High	Long	5	B	.10	3.97	1.47	.87	1.80	1.13	1.03
High	Long	5	A	.32	5.16	1.29	.77	1.35	.74	.52

Table 2
Multivariate Analysis of Variance of Intralist, Extralist, and Omission Errors on the Cloze Recall Task

Source	df	Significance Level			
		Multivariate	Univariate		
			Intralist	Extralist	Omission
Arousal	3	.64			
Retention Interval	3	.0001	.1149	.0001	.0001
Distance from Arousal Word	6	.0001	.0001	.0001	.0001
Before vs. After	3	.0007	.0001	.4879	.7930
Arousal X Interval	3	.1665			
Arousal X Distance	6	.4003			
Arousal X Before-After	3	.0009	.2860	.0027	.2419
Interval X Distance	6	.1502			
Interval X Before-After	3	.1246			
Distance X Before-After	6	.0001	.0001	.0001	.2933
Arousal X Interval X Distance	6	.6046			
Arousal X Interval X Before-After	3	.7504			
Arousal X Distance X Before-After	6	.0096	.4279	.0088	.6678
Interval X Distance X Before-After	6	.1166			
Arousal X Interval X Distance X Before-After	6	.4518			

word, without regard to direction or arousal condition. The means are summarized in Table 4. Two error types—extralist and omission—increased with distance from the arousal word, whereas intralist errors decreased. More accurately, omission errors increased from one to three words distant from the arousal word, but were essentially unchanged from three to five words removed. The intralist errors were so negligible, and the differences so negligible relative to the data on extralist and omission errors, that the decrease in intralist errors with distance from the arousal word is difficult to accept as psychologically significant, particularly given the large N which was instrumental in this difference achieving statistical significance. To find out exactly where the differences were, t tests were undertaken, the results of which are summarized in Table 5. Of particular interest to the present study is

Table 3
Mean Errors as a Function of Retention Interval

Error Type	Retention Interval	
	Short-Term	Long-Term
Extralist	2.856	4.156
Intralist	0.446	0.523
Omissions	1.999	1.155

Table 4
Mean Errors as a Function of Distance from the Arousal Event

Error Type	Distance		
	One Word	Three Words	Five Words
Extralist	3.033	3.409	4.078
Intralist	0.625	0.520	0.249
Omissions	1.090	1.869	1.774

Table 5
Tests of the Differences Within Error Types as a Function of the Distance from the Target Word

Error Type	Test	t	df	p <
Extralist	1 word away vs. 3 words away	2.38	476	.01
	3 words away vs. 5 words away	3.36	479	.005
	1 word away vs. 5 words away	6.14	481	.005
Intralist	1 word away vs. 3 words away	2.60	476	.005
	3 words away vs. 5 words away	4.92	479	.005
	1 word away vs. 5 words away	7.88	481	.005
Omission	1 word away vs. 3 words away	3.98	476	.005
	3 words away vs. 5 words away	.43	479	NS
	1 word away vs. 5 words away	3.48	481	.005

the significant contribution of word arousal as indicated in the arousal by before-after interaction for extralist errors noted in Table 2. The means for this significant interaction are plotted in Table 6. From Table 6 it can be seen that extralist errors were greater before and fewer after the high arousal words relative to low arousal words, where extralist errors were fewer before and more after. The second order interaction of arousal by distance by before-after was also significant for extralist errors. The means are presented in Table 7, as presentation in a figure is not possible. Such an interaction as represented in Table 6 is difficult to interpret, and probably would not survive replication.

No significant effects of any experimental manipulations on any of the four attitude scale responses were obtained.

Table 6
Mean Errors as a Function of Arousal and Direction of the Target Word from the Arousal Word

	Direction	
Arousal Condition	Before	After
Low Arousal	3.282	3.813
High Arousal	3.643	3.287

Table 7
Mean Extralist Errors as a Function of Arousal, Direction, and Distance from the Arousal Word

Direction and Distance of Target Word from Arousal Word	Arousal Condition	
	Low Arousal	High Arousal
Before		
1 word distant	2.225	3.220
3 words distant	3.585	4.380
5 words distant	4.035	3.330
After		
1 word distant	3.610	3.075
3 words distant	3.205	2.465
5 words distant	4.625	4.320

IV
Discussion

The ranked order of error frequencies from highest to lowest was extralist-omission-intralist errors. The latter were so negligible as to be almost not worth analyzing. Using such error analyses, no clear-cut "spread of arousal" effect was obtained. However, and of some theoretical interest, the extralist error analysis revealed that the high-arousal words significantly facilitated performance in a forward direction and inhibited or impaired it in a backward direction relative to the effects of the low-arousal words, which inhibited or impaired performance in a forward direction and facilitated it in a backward direction. The direction of this interaction was the same, though not significant, for omission errors. The forward and backward effects of arousal did not interact with distance of the target word from the arousal word. Thus where high arousal words were concerned, no arousal gradient was obtained, but simply a forward facilitating and a backward inhibiting effect relative to the effect of the low-arousal words. This effect, it should be noted, did not interact with retention interval. In fact, no variables interacted significantly with retention interval. The lack of a significant interaction of arousal and retention interval is generally in line with other studies of arousal and prose learning, as noted earlier. If recall of the arousal words themselves had been tested, however, then superior recall of these words probably at both the STR and LTR tests, but certainly the LTR test, might have been expected on the basis of Farley's (1969) study.

The significantly greater incidence of intralist errors before than after the arousal words suggests that the earlier rather than later words in the sentences had greater similarity within the passage, leading to interference and intralist commission errors. However, the very low incidence of intralist errors, as noted earlier, makes extended discussion of them of dubious value.

The systematic study of word arousal effects and "arousal events" in prose should ultimately be of great benefit to the development of children's reading material. Maintaining arousal and attention is here assumed to be important in learning from text. There is evidence by Rothkopf and others that may be interpreted as supporting this position.

Finally, although the present analysis was based on a cloze-type recall measure rather than the more usual questionnaire, the high correlations usually reported between cloze comprehension measures and other comprehension measures suggest that cloze and cloze-like techniques of assessment are reflecting central properties in the processing of prose.

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